

Migration: a theoretical comparison on countries' welfare¹

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Abstract

We compare the effects of migration on the production of public goods, income taxes, and on the welfare of residents in the sending and in the receiving country. Migration is driven by income differences between countries. Alternative wage adjustment scenarios are considered: fully flexible wages; upward rigidity, and unemployment. We show that in all scenarios, emigration is welfare detrimental for the origin country. Migration is welfare improving for the destination country in presence of flexible wages and upward rigidity, but it has detrimental effects in presence of unemployment.

Key words: migration, public good, income tax, labor market rigidities.

JEL codes: F2, H2, H4.

1 Introduction

In this paper, we compare the effects of migration on the production of public goods, income taxes, and on the welfare of residents in the sending and in the receiving country. We proceed in a simple standard model by comparing the welfare levels reached before and after migration in each country.

When economic circumstances are favorable, rich countries are fond of receiving migrants coming from the poor regions. By contrast, under recession, when even in prosperous areas unemployment is present, rich countries seem to be reluctant to welcome migrants, in particular because they occupy vacancies no longer available for their own residents. On the one hand, such population movements impact the economic welfare of residents in both countries but this impact varies according to the economic circumstances characterizing the economic activity. Among these characteristics, one plays a crucial role: the gross wage rate, and how it reacts to the pressure coming from the excess supply (resp. demand) that migration generates on the labor market. The gross wage rate also depends on technological productivity and on the existence of rigidities on the labor market. On the other hand, the net wage rate depends on the level of income taxes levied to finance public goods. Thus, migration affects the level of public goods supplied in the destination and the origin country and, consequently, the income taxes that have to be levied to finance the production of public goods.

The basic ingredients we have just evoked constitute the building blocks of the model in which we analyze the impact of migration on residents' welfare in the destination and the origin countries. As stressed above, the economic environment matters in this analysis. How the income tax is selected by the governments and how the wage rate is determined generate several different scenarios. We assume that the income tax in each country is selected by the Government in order to maximize the residents' welfare *via* the production of a public good financed by the tax proceeds. As for the labor market, we analyse several alternative scenarios. In the first one, it is assumed that the gross wage adjusts in each country instantaneously at its equilibrium value. In the destination country, a larger labor force is now available due to migration, so that, with a wage rate at equilibrium before migration, instantaneous adjustment entails a smaller wage rate *ex-post* migration. On the contrary, in the origin country, less workers are now available, and the wage rate has to increase under instantaneous adjustment.

In the second scenario, we assume that the wage rate does not adapt instantaneously but

remains rigid. Two subcases must immediately be distinguished in this scenario. If at the *ex-ante* wage in the destination country there exists some unfilled vacancies, these vacancies can then be filled in with migrants arriving from the origin country. On the contrary, when unemployment exists, the arrival of migrants necessarily deteriorates labor market conditions. Then we assume that this migration creates a pressure to substitute some migrants to natives in their existing jobs, so that the pool of jobless people now includes both some natives having lost their job and some migrants. To each of these scenarios corresponds a different impact of migration on the welfare of residents and it is precisely this impact that we analyze in the following sections.

In this analysis, we assume that preferences of the agents over the private and public good are represented by a quadratic utility function. We obtain some precise answers to our initial question under this assumption. We examine when migration improves or alternatively deteriorates the welfare of the residents both in the origin and destination countries under the three alternative scenarios: instantaneous wage adjustment after migration, upward and downward wage rigidity.

Our findings are as follows. In the first scenario, when the wage rate adjusts instantaneously to its new equilibrium value after migration, we show that migration is welfare improving in the destination country. Migration generates at the *ex-post* equilibrium an increase in the public good produced and, accordingly, an increase in the income tax needed to finance this *extra* public good production. Furthermore, due to the labor market flexibility assumption, the flow of migrants yields a decrease in per capita income. These combined effects reflect however an overall positive impact on natives' welfare level. As for the origin country, the effect on the residents' welfare turns out to be the reverse of that observed in the destination country: the impact is always welfare detrimental.

The second scenario corresponds to the situation when the wage does not adjust instantaneously to its equilibrium value. Under this hypothesis, we must distinguish whether, before migration, there are, or there are not, some unfilled vacancies at the fixed existing wage rate. In the first case, arriving migrants can fill in these vacancies in the destination country. We show that, as a result, immigration is always beneficial for natives in the destination country. This solution corresponds to intuition. With existing vacancies still not yet filled in the labor market of the destination country, migration from abroad due to income differences between the two countries increases the home production of the public good while it provides a higher net

income to the migrants. The result is again negative for the origin country: assuming upward rigidity of wages, emigration lowers the level of welfare of natives in the origin country.

Going on with the third scenario, we assume that, before and after migration, unemployment exist both in the origin and in the destination country. After migration has taken place, those who work are randomly selected among the natives and the migrants in the new pool of the labor force. We also assume that an unemployment benefit is provided to those who do not find a job. Then, we prove that under downward rigidity of the wage rate, immigration has negative effects on welfare of natives in the destination country as well as in the origin country.

Thus, in a nutshell, emigrations are always detrimental for the origin country, while they are often welfare improving for the destination country, unless this last suffers from unemployment. Notice however that this conclusion relies on specific linear quadratic preferences of the population over the private and public good. The latter assumption while making our analysis particular, allows us to stress the major elements prone to determine the impact of migrations on welfare in a general context.

The model is defined in section 2. Flexible wages are considered in section 3. Rigid wages are analyzed in section 4 with two subsections, downward and upward rigidity. Section 5 details the existing literature. Finally a short conclusion closes the paper.

2 The model

We consider a stylized model to describe the basic insights of the effects of migratory flows on the welfare of the residents of the origin and destination country. Assume two countries, H and F each imposing income taxes t_i $i = H, F$ on their residents with the aim of using tax proceeds to supply *local* public goods Y_i , $i = H, F$. Individuals are free to choose where to live.

Population in each country is distributed over types and the set of types is represented in each country by the $[0, 1]$ interval. Heterogeneity of population captures heterogeneity on the cost of migrating x , $x \in [0, 1]$. The higher x , the higher the cost of living abroad. The reasons why the cost of moving abroad is not the same across the population of residents are many. Some of them are strongly attached to their relatives living in their residential area, while others are considerably more mobile, simply because they have weaker links with people living around them (see Beine *et al* (2011) for the role of diasporas on migration). National traditions, patriotism, and historical origins constitute significant values for some individuals,

while they let others, -who feel like *citizens of the World*-, almost indifferent.

The utility of an individual who is a native of country i and who lives in country i , $i = H, F$ is given by

$$U_i = (2 - Y_i)Y_i + w_i(1 - t_i), \quad i = H, F :$$

The first component of the function U_i captures the utility derived by the consumption of the public good with $Y_i \leq 1$. The second component of the above utility function is the amount of private good consumed when the price of this good is normalized to one. Each agent owns exactly one unit of labor L that he/she splits eventually between the production of the public good and that of the private good. Let the technology in each country be $2k_i\sqrt{L}$ with $k_i > 0$, $i = H, F$, and $k_H > k_F$. For simplicity, assume $k_H = 1$. The variable w_i denotes the real wage obtained in exchange of participating in production of the private good. Thus we assume that there exists a *technology gap* between the two countries: the marginal product of labor is larger in country H than in country F . Only if the labor market is competitive, the equilibrium level w_i^* of the real wage equals the marginal product of labor. Nonetheless, we assume that the wage w_i can be fixed at any level and entailing either unemployment in case of excess labor supply, or free vacancies in case of excess labor demand. Since taxes are levied with the aim of financing the public good, the budget constraint of each government is given by

$$Y_i = t_i w_i^0, \quad i = H, F \tag{1}$$

where the superscript 0 refers to the no migration solution. Then, using (1), we have

$$t_i^0 = \frac{Y_i}{w_i^0}, \quad i = H, F.$$

In order to decide the amount of public good to be produced, the government in country i maximises the level of utility of its residents under the budget constraint, namely:

$$\begin{aligned} & \text{Max}_{Y_i} (2 - Y_i)Y_i + w_i^0(1 - t_i) \\ \text{s.t. } & t_i^0 = \frac{Y_i}{w_i^0}. \end{aligned}$$

The objective function is concave; so using the first order condition, we obtain

$$(Y_i^0)^* = \frac{1}{2} \quad (t_i^0)^* = \frac{1}{2w_i^0} \quad i = H, F. \tag{2}$$

The tax rate should satisfy $0 < t_i^* < 1$, then $0 < \frac{1}{2w_i^0} < 1$ implying that $w_i^0 > \frac{1}{2}, i = 1, 2$.

Consequently, the level of utility $(U_i^0)^*$ corresponding to the choice of taxes and public good level is given by

$$(U_i^0)^* = w_i^0 + \frac{1}{4}, \quad i = H, F. \quad (3)$$

It follows that the level of utility of an individual living in country H is strictly higher than the level of utility of an individual living in country F , if and only if $w_H^0 > w_F^0$. This difference in wages incites some individuals in country F to leave their country and migrate towards country H to take advantage of the higher level of utility in this country. It is easy to see that this set of migrants is exactly given by the interval $[0, x]$ where x is defined by¹

$$x = w_H^0 - w_F^0.$$

The flow of migrants should not exceed one by construction, so it must hold that $w_H^0 - w_F^0 < 1$. All individuals at the left of x on the unit interval have a cost of migration that is inferior to $w_H^0 - w_F^0$, and thus they will migrate from F to H . It follows that, after the migration, the number of individuals whose type belong to the interval $[0, x]$, who live in H , is now doubled. Both governments anticipate this migratory flow. Hence, country H anticipates that its population after migration will be

$$\begin{cases} 2 & \text{over the interval } [0, w_H^0 - w_F^0] \\ 1 & \text{over the interval } [0, 1], \end{cases}.$$

with w_H^0 on the interval $[0, 1]$ and w_F^0 on the interval $[0, w_H^0 - w_F^0]$.

The effects of migration on the production of the public good in the destination country and corresponding taxes, and accordingly on the resulting welfare of natives, depends crucially on the mechanism of wage adjustment in the labor market, depending whether there is excess labor demand or excess labor supply after migration has taken place.

In the following sections we analyze two scenarios. In the first, we assume *à la* Harris–Todaro (1970) that the wage after migration adjusts to the new labor supply in both countries, so that full employment is reached before and after migration. In the second scenario, we assume

¹Assimilating the set of migrants to this interval implicitly assumes that migration is only motivated by differences in gross wages, which does not take into account that migrants could also anticipate the level of future real income taxes, serving in the production of the public good.

wage rigidity. Downward rigidity implies that the flow of migrants creates unemployment in the destination country. On the contrary, upward rigidity generates an excess demand for labor, implying that migration reduces the number of vacancies in the destination country. Corresponding to each of these scenarios we ask the question: who wins and who loses from migration?

3 Flexible wages

In this section, we assume that wages always instantaneously adjust in each country in order to clear the labor market. Consequently, the equilibrium wage in country H (resp. F) corresponds initially to the competitive wage, namely $w_H^0 \equiv w_H^* = 1$ (resp. $w_F^0 = w_F^* = k_F$): $w_H^0 > w_F^0$. These wages now adapt to the new labor market conditions after migration.

Let us first consider the destination country H . The new labor supply in country H is $1+x \equiv 1+(w_H^0 - w_F^0) = 2 - k_F$, and the corresponding level of wage at the new full employment equilibrium after migration, in country H is $w_H^{1*} = 1/\sqrt{2 - k_F}$. Similarly, the new labor supply in country F is $1 - x \equiv 1 - (w_H^0 - w_F^0) = k_F$, and the wage level at the full employment equilibrium is now $w_F^{1*} = \sqrt{k_F}$.

The government in country H decides the level of public good in accordance with the new level of wage w_H^{1*} on which the income tax will be levied. The new budget constraint writes as

$$Y_H \leq t_H w_H^{1*} + t_H (w_H^0 - w_F^0) w_H^{1*}.$$

Solving the above for the tax rate we find:

$$\hat{t}_H^1 = \frac{Y_H}{w_H^{1*} (1 + (w_H^0 - w_F^0))}.$$

Then the problem solved by the government in country H is

$$\begin{aligned} & \text{Max}_{Y_H} (2 - Y_H) Y_H + w_H^{1*} (1 - t_H) \\ \text{s.t. } t_H^1 &= \frac{Y_H}{w_H^{1*} (1 + (w_H^0 - w_F^0))}. \end{aligned}$$

Using the first order condition and substituting $w_H^0 = 1, w_F^0 = k_F, w_H^{1*} = 1/\sqrt{2 - k_F}$, we obtain

$$\hat{Y}_H^1 = \frac{3 - 2k_F}{4 - 2k_F} \quad (4)$$

and the corresponding tax is then

$$\hat{t}_H^1 = \frac{\hat{Y}_H^1}{w_H^{1*} (1 + (1 - k_F))}. \quad (5)$$

Hence, we claim the following proposition.

Lemma 1 *Assuming flexible wages, migration leads to an increase in the public good and taxes in the destination country.*

Proof. Directly comparing (4) and (5) with (2). ■

The comparison of the level of utility with and without migration under flexible wages is ambiguous. Directly comparing the level of utility of the residents of country H before and after migration yields the following result.

Proposition 1 *Assuming flexible wages, free immigration is welfare improving for residents in the destination country.*

Proof. To prove the proposition, we take the difference of the utility functions (3) with the level of utility after migration, namely $w_H^0 + \frac{1}{4} - \left[(2 - \hat{Y}_H^1) \hat{Y}_H^1 + w_H^{1*} (1 - \hat{t}_H^1) \right]$, evaluated at the optimal taxes and public goods corresponding to the before and after migration scenarios. If this difference is negative, then the level of utility before migration is lower than the utility after migration. Substituting the expressions of \hat{Y}_H^1 and \hat{t}_H^1 , the difference is given by $\frac{1}{4} \frac{11 - 8k_F - 4(2 - k_F)\sqrt{2 - k_F} + k_F^2}{(2 - k_F)^2}$. Then, the sign of the difference in utility before and after migration is determined by the sign of the denominator $D \equiv 11 - 8k_F - 4(2 - k_F)\sqrt{2 - k_F} + k_F^2$. The expression D admits two solutions in k_F , one solution is negative and the other solution is equal to 1. The sign of D is clearly negative for any admissible value of k_F , namely for $k_F \in (0, 1)$. ■

The intuition behind this result is as follows. According to Lemma 1, in country H migration entails an increase in the public good but due to labor market flexibility the flow of migrants yields also a decrease in wages. These combined effects would reflect a negative (resp. positive) impact on natives' welfare level if and only if the income share dedicated to public good is smaller (resp. larger) than that dedicated to the private good. In our framework, migration positivity

impacts natives' welfare because the increase in public good level more than compensates for the decrease in private income.

Origin country. Following the same procedure as for the destination country, we identify the optimal solution for the public good level and the resulting income tax before migration, namely $\hat{Y}_F^0 = \frac{1}{2}$ and $\hat{t}_F^0 = \frac{1}{2k_F}$ and after migration, i.e., $\hat{Y}_F^1 = \frac{2k_F-1}{2k_F}$ and $\hat{t}_F^1 = \frac{1}{2} \frac{2k_F-1}{(\sqrt{k_F})^5}$. A direct comparison of these amounts reveals that emigration decreases the level of public good provided as well as the tax paid by the citizens left behind in country F . Taking the difference between the level of welfare after and before migration, we obtain

Proposition 2 *Assuming flexible wages, emigration is always welfare detrimental for residents in the origin country.*

Proof. The sign of difference in welfare after and before migration is given by the sign of $-\left(k_F + 2k_F^{\frac{3}{2}} - 1\right)$, which is negative for $k_F > 1/2$ which is assumed to hold for the positivity of taxes. ■

In the case of the origin country, migration entails a decrease in the public good level and taxes, whereas the wage rate increases from k_F to $\sqrt{k_F}$ (where $k_F > 1/2$). The overall effect of the residents' welfare of the origin country depends upon the balance of these effects. The loss in utility resulting from the decrease in public good dominates the benefit resulting from the wage increase. Hence, comparing Propositions 1 and 2, we observe that migration is never a "win-win" game.

Now that we have fully elucidated the effects of migration under a flexible wage regime, we move to the analysis of migration when wages are rigid. As we explained earlier, two possible regimes can be envisaged at any pre-existing wage level w_i^0 , $i = H, F$. In the first, upward wage rigidity at the level w_H^0 generates free vacancies *ex ante* migration. In the second regime, downward rigidity at the level w_H^0 generates unemployment. We start with the first regime.

4 Rigid Wages

4.1 Excess demand of labor

Assuming upward wage rigidity at the level of w_H^0 , the budget constraint of country H after migration becomes

$$Y_H \leq t_H w_H^0 + t_H (w_H^0 - w_F^0) w_H^0.$$

Hence, the government receives a tax receipt from the native population equal to $t_H w_H^0$ and, in addition, a tax receipt equal to $t_H(w_H^0 - w_F^0)w_H^0$ from the migrants whose flow is precisely $w_H^0 - w_F^0$. Solving the above for the tax rate we find:

$$t_H^1 = \frac{Y_H}{w_H^0 + (w_H^0 - w_F^0)w_H^0}.$$

where the superscript 1 indicates the period after migration has taken place.²

The objective function of the government of country H is the utility of its residents before migration takes place³. The problem of the government in H writes as :

$$\begin{aligned} \max_{Y_H} \quad & (2 - Y_H)Y_H + w_H^0(1 - t_H^1) \\ \text{s.t. } t_H^1 \geq \quad & \frac{Y_H}{w_H^0 + (w_H^0 - w_F^0)w_H^0}. \end{aligned}$$

Using the first order condition we obtain:

$$(Y_H^1)^* = \frac{1}{2} \frac{1 + 2(w_H^0 - w_F^0)}{1 + w_H^0 - w_F^0} > 0 \quad (6)$$

The corresponding level of taxes in country H is given by

$$(t_H^1)^* = \frac{1}{2} \frac{1 + 2(w_H^0 - w_F^0)}{w_H^0(1 + w_H^0 - w_F^0)^2} > 0.^4 \quad (7)$$

Then, directly comparing the equilibrium levels of the public good and taxes before and after migration, we conclude that

Lemma 2 *Migration increases both the level of public good and the level of taxes in the destination country.*

Proof. Directly comparing (6) and (7) with (2). ■

Thus, this proposition does not allow us to conclude whether migration is welfare detrimental or improving in the destination country, since migration increases the level of public good but

²Notice that in this section, we assume that the flow of migrants $w_H^0 - w_F^0$ does not exceed the number of vacancies in the destination country. If that would be the case, then we would fall into the unemployment scenario that is analysed in Section 5.2.

³This assumption could be justified for instance by supposing that the existing government must be reelected and that the future voters in the election consist only of the native residents.

⁴Notice that keeping our assumption $w_H > 1/2$ (assumed for positivity of taxes in Section 1), guaranties that t_H^{1*} does not exceed 1.

increases the tax as well. To clarify this ambiguity, we compare the level $(U_H^0)^*$ and $(U_H^1)^*$ of the utilities obtained by natives before and after migration. This difference writes as

$$(U_H^0)^* - (U_H^1)^* = \frac{1}{4} (3(w_H^0 - w_F^0) + 2) \frac{w_F^0 - w_H^0}{(w_F^0 - w_H^0 - 1)^2},$$

which is clearly negative due to $w_F^0 - w_H^0 < 0$. Hence, we claim the following

Proposition 3 *Assuming upward wage rigidity, immigration is always beneficial for natives of the destination country.*

Under upward wage rigidity, the destination country is fond of welcoming migrants because it allows to fill available vacancies. It is not surprising that the increase in the production of public good leads to an increase in welfare, given that the tax does not change and the level of income remains the same as before migration.

Origin country. Similarly, to the above analysis, we can identify the optimal choice of the government in F as follows $(Y_F^1)^* = \frac{1}{2} \frac{2w_F^0 - 2w_H^0 + 3}{w_F^0 - w_H^0 + 2}$ and $(t_F^1)^* = \frac{1}{2} \frac{2w_F^0 - 2w_H^0 + 3}{w_F^0 (w_F^0 - w_H^0 + 2)^2}$. As before, it is unclear whether emigration generates a decrease or an increase in the welfare of the residents of the origin country, being the level of public good and taxes higher after migration. To clarify this ambiguity we make the direct comparison between the level of the utility ex-ante and ex-post migration. It turns out that

Proposition 4 *Emigration is always welfare detrimental for the residents in the origin country.*

Proof. Directly comparing the level of utility for the residents in the origin country before and after migration we obtain $\frac{1}{4} (1 - (w_H^0 - w_F^0)) \frac{3(w_H^0 - w_F^0) - 5}{(w_F^0 - w_H^0 + 2)^2}$ which is clearly negative for $w_H^0 - w_F^0 < 1$. This is always satisfied being $w_H^0 - w_F^0$ (the flow of migrants) strictly smaller than one by construction. ■

4.2 Unemployment: downward rigidity of wages

In this section, we assume that due to downward wage rigidities in the labor market, wages do not adjust to clear the labor market *neither before nor after migration* yielding unemployment before and after migration.⁵ We examine this situation by revisiting the benchmark setting of

⁵This rigidity can be due to a bargaining between the government and the trade unions in the country of destination that takes place before migration, as in Fuest and Thum (2000).

country $i = H, F$ before migration *in presence of unemployment*. As in Section 2, since taxes are levied with the aim of financing the public good, the budget line of each government is given by

$$Y_i = t_i w_i^0 (1 - u_i^0), \quad i = H, F \quad (8)$$

where the superscript 0 refers to the initial period when no migration has taken place and u_i^0 is the unemployment rate, before migration, in each country. Analysing the labor market in each country, the level of unemployment at the rigid wage w_H^0 and w_F^0 is equal to $u_H = 1 - \frac{1}{(w_H^0)^2}$ and $u_F = 1 - (\frac{k_F}{w_F^0})^2$.

Using the expression of the budget line, we have

$$t_i^0 = \frac{Y_i}{w_i^0 (1 - u_i^0)}, \quad i = H, F.$$

We assume that the unemployed workers receive an unemployment benefit b exogenously defined and the same in each country. Then, in order to decide the amount of public good to be produced, the government in country i maximises the level of utility of its employed and unemployed residents, EU_i , under the budget constraint, namely:

$$\begin{aligned} \max_{Y_i} \quad & EU_i = (1 - u_i^0) ((2 - Y_i)Y_i + w_i^0(1 - t_i)) + u_i^0 ((2 - Y_i)Y_i + b) \\ \text{s.t. } \quad & t_i^0 = \frac{Y_i}{w_i^0 (1 - u_i^0)}. \end{aligned}$$

The objective function is concave so that we use the first order condition and obtain

$$(Y_i^0)^* = \frac{1}{2} \quad \text{and} \quad (t_i^0)^* = \frac{1}{2w_i^0(1 - u_i^0)} \quad i = H, F. \quad (9)$$

If there is no unemployment, $u_i^0 = 0$, then the optimal level of public goods and taxes coincide with the corresponding levels of the benchmark setting in Section 2. For tractability, we assume that $u_H^0 = u_F^0 = u$.⁶ Then, the level of expected utility EU_i evaluated at the optimal choices is given by

$$(EU_i)^* = w_i^0 (1 - u) + bu + \frac{1}{4}, \quad i = H, F \quad (10)$$

⁶This simplifying assumption imposes conditions on k_F but this is not an issue when wages rigid.

For later use, we also calculate the utility $(U_i^0)^*$ for the employed citizens and $(UN_i^0)^*$ for the unemployed ones in country i , once uncertainty in the labor market is revealed. We obtain

$$\begin{aligned}(U_i^0)^* &= \frac{3}{4} + w_i^0 - \frac{1}{2(1-u)}, \quad i = H, F. \\ (UN_i^0)^* &= \frac{3}{4} + b, \quad i = H, F.\end{aligned}\tag{11}$$

After migration, we assume that some random mechanism selects those among the population of native and migrants who will be employed or unemployed.⁷ Thus, the employed workers in country H after migration are natives who were not fired as well as migrants who were hired. Furthermore, we assume that the unemployed workers of mass x receive an unemployment benefit b exogenously defined, with $w_F^0 - \frac{1}{2(1-u)} \geq b$ and $w_F^0 < w_H^0$. Consequently u is on the left of x where x is defined as $w_H^0 - w_F^0$. Then, the set of migrants is exactly given by the interval $[0, x]$ with x defined by

$$x = w_H^0 - w_F^0.$$

The budget constraint of country H after migration is then given by

$$Y_H \leq t_H w_H^0 (1 - u_H) - b (w_H^0 - w_F^0) - b u_H.$$

Solving the above for the tax rate we find

$$t_H^1 = \frac{Y_H}{w_H^0 (1 - u_H)} + b \frac{w_H^0 - w_F^0 + u_H}{w_H^0 (1 - u_H)}.$$

where the superscript 1 indicates that migration has taken place.

The unemployment rate in country H is given by $\frac{x+u}{1+x}$. Then, a portion of $\frac{1-u}{1+x}$ native residents is employed after migration has taken place. Accordingly, the preferences of a resident in country H now appears as an expected utility with probabilities to be employed or unemployed. Thus, the problem faced by the government in country H is then

$$\max_{Y_H} \frac{1-u_H}{1+w_H^0-w_F^0} ((2 - Y_H)Y_H + w_H^0(1 - t_H^1)) + \frac{u_H+w_H^0-w_F^0}{1+w_H^0-w_F^0} ((2 - Y_H)Y_H + b) \tag{12}$$

$$\text{s.t. } t_H^1 = \frac{Y_H}{w_H^0(1-u_H)} + b \frac{w_H^0-w_F^0+u_H}{w_H^0(1-u_H)} \tag{13}$$

The solution of the above problem yields the optimal choice of public good level Y_H^{1*} as follows

⁷This assumption was introduced by Schmidt *et al.* (1994).

$$(Y_H^1)^* = \frac{1}{2} \frac{1 + 2(w_H^0 - w_F^0)}{1 + w_H^0 - w_F^0} \quad (14)$$

and the corresponding level of taxes $(t_H^1)^*$ obtains as

$$(t_H^1)^* = \frac{(Y_H^1)^*}{w_H^0(1-u)} + b \frac{w_H^0 - w_F^0 + u}{w_H^0(1-u)} \quad (15)$$

which is admissible smaller than one if and only if $u < 1 - \frac{1}{2} \frac{1+2w_H^0-2w_F^0}{w_H^0(1+w_H^0-w_F^0)}$. It is interesting to notice that a welfare maximizing government selects an optimal level of public good $(Y_H^1)^*$ that does not depend on the level of unemployment u . By contrast, the decision of optimal taxes on private income involves the rate of unemployment: the higher u , the higher the income tax. Hence, in our setting, a benevolent government decides the level of public good by taking into account only the tax base (the number of agents located in the country). It levies taxes on private income to sustain the public budget needed to cover the total amount of unemployment benefits as well as the public good provision.

By direct comparison of optimal choices of public levels and taxes before and after migration we observe that

Lemma 3 *Migration increases both the level of public good and the level of taxes in the destination country.*

Proof. Directly comparing (14) and (15) with (9). ■

Given Lemma (3), what are the welfare effects of migration in the destination country? In presence of unemployment migration effects proliferate. First, the public budget covering unemployment benefits increases with the arrival of migrations: a higher number of agents will demand the unemployment benefit (the pool of unemployed workers passes from u to $u + x$). Hence, in this scenario, migration increases the public expenditure via two channels: higher total amount of unemployment paid and higher level of public good provided. Such a budget increase can only be sustained through a higher tax on private income in the *post-migration* period. By contrast, in the scenarios in Sections 3 and 4.1 where unemployment was absent, migration increases the public spending in public goods and larger tax revenues in post-migration period, are entirely dedicated to the increase in public good provided to natives of the destination country. For this reason, in the flexible wage scenario as well as in the upward wage rigidity scenario, the arrival of migrants is welfare improving. Whereas with downward

wage rigidity, immigration may cause larger negative effects on the working natives because the increase in the *post*-migration tax revenue is not entirely devoted to a higher public good but also to a higher bill on unemployment benefits. Hence, the increase in public good level may be insufficient to compensate for the increase in taxes, leading to detrimental effects for the working natives.

Second, migration increases the chance to become unemployed for the native population who was working before migration. Consequently, there are natives that will certainly move from working to being unemployed. The unemployed natives before migration will have it harder to find a job with a higher rate of unemployment. Nonetheless, an unemployed native surprisingly may see his level of utility increase with migration if in the ex-post migration scenario they remain unemployed. In fact, for this category of agents, migration increases the level of public good provided, without decreasing the level of unemployment benefit b .

To investigate the overall welfare effect of migration on natives, we first compare the expected utility before and after migrants' arrival. We find the following results:

Proposition 5 *Under downward rigidity, immigration is welfare detrimental for natives of the destination country.*

Proof. The difference of expected utilities before and after migration is positive (implying welfare detrimental effects) if the following inequality is satisfied

$$4(-w_F^0 + w_H^0 + 1) \left(\begin{array}{l} (w_H^0 - w_F^0 + 1)b + \\ + (w_F^0 w_H^0 - (w_H^0)^2) \end{array} \right) u > - \left(\begin{array}{l} -3w_F^0 - w_H^0 - 4(w_H^0)^2 + \\ + 4w_F^0 w_H^0 + 2 \end{array} \right) (w_F^0 - w_H^0).$$

Notice first that the RHS of the inequality is always negative for $w_H^0 - w_F^0$ and $w_F^0 > 1/2$. Hence, if the LHS is positive the above inequality is always true. The LHS is positive, i.e. $(w_H^0 - w_F^0 + 1)b + (w_F^0 w_H^0 - (w_H^0)^2) > 0$ iff $b > w_H^0 \frac{w_F^0 - w_H^0}{w_F^0 - w_H^0 - 1}$. Then for $b > w_H^0 \frac{w_F^0 - w_H^0}{1 + w_H^0 - w_F^0}$, migration is welfare detrimental. By contrast, if the LHS is negative i.e. $b < b'$, then, migration is welfare detrimental if $u < u' \equiv -\frac{(-3w_F^0 - w_H^0 - 4(w_H^0)^2 + 4w_F^0 w_H^0 + 2)(w_F^0 - w_H^0)}{4(-w_F^0 + w_H^0 + 1)(b - bw_F^0 + bw_H^0 - (w_H^0)^2 + w_F^0 w_H^0)}$ and welfare beneficial if $u > u'$. Nonetheless, as we saw, equilibrium taxes require $u < 1 - \frac{1}{2} \frac{1 + 2w_H^0 - 2w_F^0}{w_H^0(1 + w_H^0 - w_F^0)}$, which is a more restrictive condition than $u < u'$ as long as $b < b'$. Hence, migration is never welfare improving because u cannot lie in the interval $u > u'$ with $b < b'$. ■

To understand the intuition behind the Proposition we shall consider the fact that migration affects differently the utility of a native who works and a native who is unemployed. The

workers bear higher taxes and benefit a higher public good after migration. The unemployed workers only benefit higher public good. But the weight of workers and unemployed ones in the objective function of the government (12) depends on the rate of unemployment u . Therefore, the overall impact of immigration on the expected utility depends on how much b and u affects the increase in taxes (detrimental for natives who work) and the corresponding increase in public goods (beneficial for everyone) taking into account the allocation of these effects among natives who work and those who don't, which in turn depends on the level of u .

Migration is welfare detrimental when b is large regardless of the level of u , because very large unemployments benefits direct lots of resources away from the provision of public goods. Migration is welfare detrimental also when b is not very large and u is not large. In fact, the unemployment rate in our setting affects negatively the opportunity cost of being unemployed. The unemployment rate affects negatively the level of utility of a working native before migration (see equation 11). The higher the level of unemployment, the higher the total unemployment benefits to be paid, the smaller the net wage of a worker who bears the cost of the unemployment benefits. Hence, the higher the unemployment rate, the smaller the difference in utility levels between a working and an unemployed native.⁸ Furthermore, the unemployment rate affects positively the level of taxes after migration (see 15). Therefore u further reduces the opportunity cost of being unemployed after migration. As long as the weight of the unemployed workers in the objective function in (12) is not very big even when the unemployment benefit is not big, migration remains always welfare detrimental.

Origin Country. We turn now the attention to the origin country F . For this country, the budget constraint after emigration is

$$Y_F \leq t_F w_F^0 (1 - u) - b (u - (w_H^0 - w_F^0)).$$

Country F pays the unemployment benefit to a smaller pool of unemployed: $u - (w_H^0 - w_F^0)$. Following the same analysis as for country H , we find that the optimal level of public goods as well as optimal taxes as follows:

$$Y_F^{1*} = \frac{1}{2} \text{ and } t_F^{1*} = \frac{1}{2} \frac{1 + 2bu - 2b(w_H^0 - w_F^0)}{w_F^0 (1 - u)}$$

⁸This is so as long as the unemployment benefit does not change with the unemployment rate, which is the assumption we make in this paper.

In the origin country, immigration leaves the public good level unchanged but it increases taxes, in fact $t_F^{0*} - t_F^{1*} = b \frac{-u + w_H^0 - w_F^0}{w_F^0(1-u)}$ which is negative being $u > w_H^0 - w_F^0$ by construction. The level of expected utility after emigration is $w_F^0(1-u) + b(w_H^0 - w_F^0) + \frac{1}{4}$. By direct comparison with the expression of the expected utility before emigration (10), we find

Proposition 6 *Assuming downward rigidity of wages, emigration is welfare detrimental for the natives of the origin country.*

It is worth to point out that emigration is always welfare detrimental for the origin country, regardless the scenario on the labor market. Existing literature has shown many detrimental effects of emigration on origin country as for instance the brain drain (see Docquier and Rapoport, 2012, for a survey). We are the first to show that this is also the case in a very simple model of public finance with homogeneous workers. As far as it concerns the destination country, immigration is very often welfare improving. The only scenario in which it has detrimental effects is with unemployment.

To summarize our results, the following table represents the effects of migrations on welfare in both the destination and the origin countries for the different labor market regimes.

	Destination country	Origin Country
Flexible Wages	+	—
Upward Rigidity	+	—
Unemployment	—	—

5 Relation to existing literature

Our approach is devoted to the welfare effects of migration, depending on the labor market rigidities and the governments' choice of the level of public good. By contrast, the existing literature examines the welfare effects of migration as a consequence of (i) the type of technology, assuming either complementarity or substitutability of immigrant workers with other factors of production as capital or native workers; (ii) the pure flexibility of the labor market.

Borjas (1995, 1999), assuming a perfectly competitive labor market and *production complementarities* between immigrant workers and other factors of production, calculates that a stock of immigrants equal to 12% of the total work force yields a native welfare gain between 0.1%

and 0.5% of GDP in the United States. A more sophisticated model of the production theory is provided in Borjas (2003). Borjas (2003) increases the number of labor aggregates using a three-level CES technology. The bottom level combines similarly educated workers with different levels of work experience into labor supply for each education group. The second stage aggregates workers across education groups into the national workforce. Finally, the upper level combines labor with capital. Estimating elasticities of substitution for each stage of the CES technology, Borjas (2003) calculates the wage impact of the immigrant influx that entered the USA between 1980 and 2000. Card (2009) provides a survey of the empirical literature that measures the inequality of wages among natives and immigrants by estimating the degree of substitutability and complementarity of domestic and immigrant workers among high skilled and low skilled, and within each group.

In absence of technology complementarities among workers, but introducing capital as a second factor of production, Michael (2003) finds that immigration is welfare detrimental. Indeed, migrants are net fiscal beneficiaries, namely, they receive more from the host government than what they pay in taxes. Instead, in presence of *international mobile capital*, immigrants make the marginal revenue product of capital increase, causing a capital inflow that increases income for native capitalists and tax receipt, making immigration welfare improving.

We depart from these works along several aspects. We assume a unique factor of production in both countries, i.e., labor, and moreover, we assume rigid labor markets. Furthermore, our focus is on the welfare effects of migration when such effects pass through the contribution of migrants to the production of the public good.

The second assumption that crucially affects the conclusions on migrants' effect concerns the labor market. This may look natural, but a majority of theoretical works so far has assumed competitive labor markets. An exception is Fuest and Thum (2000). These authors consider a two-sector, small open economy assuming that wage in one sector is defined by a wage bargaining between unions and employers. In the other sector, wage is fixed at the marginal product. Then, immigrant workers find employment in the unionized sector and drive out some of the native workers. Instead of the high union wage, natives then receive either unemployment benefits or the lower competitive wage of the sector with competitive labor market. In our paper, we take a more general view on the rigidities of the labor market by assuming downward and upward rigidities, whatever their source. Furthermore, differently from

Fuest and Thum (2000), our attention is on the governments' decision on public good levels and corresponding taxes that are affected by the flow of migrants. Finally, a crucial difference with Fuest and Thum (2000) follows from the way migration is generated in the model. We assume *à la* Tiebout that individuals decide where to reside as a consequence of income differences but, contrary to Tiebout (1956), they are assigned initially to a specific country. This allows us to derive the consequences of migration both in the receiving and the sending country.

Finally, a large body of literature is now built in public economics to study the effects of capital mobility. The main reason for capital mobility are differences in capital tax rates, which have become an important policy instrument for the local and central governments. In fact, the corresponding literature of the effects of capital mobility is built using a fiscal competition framework (for surveys and references see Wilson (1999), Wilson and Wildasin (2004), Wildasin (2006)). Governments compete to attract capital investments to alleviate unemployment, to increase employment, or simply to nourish and develop a competitive banking sector. This fiscal competition among states or local jurisdictions suffers from externalities because the tax base is mobile. Then, fiscal competition leads to a race to the bottom of capital taxes that may determine a suboptimal level of public goods supplied.

We depart from this literature because we neglect competition in income taxes. As a matter of fact, the percentage of migrants remains still quite low in almost all countries (OECD, 2013), with the exception of Switzerland or Luxembourg, who importantly depend on cross-border workers. This could suggest that the decision on income taxes reflects more a national policy rather than the result of a fiscal competition among nation-states. For this reason, we have chosen to model income taxes as the residual of the decision of each government on public investment and not as a consequence of strategic behaviour of governments, as it is depicted for capital taxation.

6 Conclusion

In the general equilibrium model defined above, we have explored the welfare effects of migration when this migration is caused by income differences between the receiving and sending country. We have fully elucidated the benefits and losses between them, as a consequence of resulting income taxes and wages. We did it for the different regimes in which the labor market of the higher wage country stands initially: fully flexible wage, excess demand or excess supply of

labor.

Of course, this elucidation must be taken cautiously. The first caveat concerns the fact that the sole engine of migration considered here is the income difference between the countries. In most real situations, migrations are motivated by several different incentives, not taken into account in our analysis. Also we assume that, except for the costs of migration, all individuals are identical while migration behaviour varies across different segments of the population (skilled-unskilled workers, retired-non retired individuals, brain drain, capitalists-workers a.s.o.). Our model has also strong specificities, like constant returns-to-scale in the production of the public good, which makes our conclusions more than particular.

The model would certainly be more realistic if mobile capital would also be introduced and different types of workers, like skilled and unskilled, would be considered. Such improvements of the model would permit the analysis of the combined effects on welfare of capital and labor mobility, like in Michael (2003). It would also allow to consider migrations, in which skilled and unskilled workers are differentiated. Then the welfare effects of migrations would certainly be more complex to disentangle, since migrations can then be beneficial for the receiving country relative to one type of workers and detrimental relative to the other.

Nevertheless, our simplified approach gives a rigorous theoretical appraisal to the often passionate debate about the pro and cons of migration related to income differences among countries. Introducing more improvements to the model and analyzing how it alter its main conclusions, would certainly constitute an attractive topic for further research.

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